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Pumped storage advocates see bright future due to new tax credits, reliability needs

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Advocates of pumped storage hydropower said last week that the sector is poised for explosive growth based on a trifecta of recent events, including the provision of new financing in Senate legislation, the growth of grid reliability concerns nationwide and deployment of intermittent, renewable generation that needs backup power.

The improved financing outlook hinges largely on an investment tax credit (ITC) for pumped storage hydropower (PSH) facilities that is included in the Inflation Reduction Act poised for passage in the Senate, which would help alleviate a major impediment for PSH project development, said LeRoy Coleman, spokesperson for the National Hydropower Association (NHA). With 92 PSH projects in development at different stages of gaining a license from the Federal Energy Regulatory Commission, the 30 percent ITC in the Senate bill "could help make some of those projects a reality," Coleman told The Energy Daily August 5.

Currently, there are 43 operating PSH facilities in the United States providing 22,878 megawatts of storage capacity and accounting for about 94 percent of grid-scale energy storage.

However, among the PSH projects under development only three have FERC licenses, noted Michael Manwaring, western region energy sector leader for Stantec, an engineering and design firm. The three with their licenses are Eagle Mountain (1,300 MW) in Southern California, Gordon Butte (400 MW) in Montana and Swan Lake (393 MW) in Oregon, Manwaring said during an August 4 interview.

While licensing and permitting requirements are some of the biggest challenges facing PSH project development, obtaining financing is also high on that list due to the way energy storage is accounted for and the limited recognition of its many benefits over a long period of time, Manwaring said.

While regulated utilities can seek to bill customers for PSH projects, independent project developers typically have trouble finding investors willing to finance projects that can take 10 years or more to go from inception to construction, even though PSH features a 50-year lifespan without degradation of output and a valuable grid-stabilizing service, said Manwaring, an NHA board member who sits on the group's Pumped Storage Development Council.

Among the storage technologies available to help integrate renewables and address intermittency, batteries have a much lower installation cost, while PSH has a longer operating horizon that can switch from pumping water—the equivalent of battery charging—to generating hydropower on short notice multiple times a day, Manwaring said. And when costs per kilowatt-hour are calculated based on the lifetime and amount of energy storage provided, PSH facilities have a lower cost than lithium-ion batteries, NHA said in a 2021 report on the topic.

Grid reliability events can last a few hours or a few days, and PSH projects can meet long-duration needs without the wear and tear that batteries suffer while charging and discharging multiple times, Manwaring added.

Newer PSH equipment is designed for up to 10 stops -- or changes from pumping water to generation – per day – while modern batteries typically have one stop and start per day over a 10-year life cycle, NHA said in the report. "More importantly, the continued use of a battery system will degrade the ability to charge and discharge over time, a PSH project shows no degradation (performance) with continued usage over its five-decade lifespan," according to the report, which has Manwaring as a contributing author.

The integration of renewables and massive growth of solar power in some states has led to changes in the way existing PSH facilities are used, with Duke Energy changing from nighttime pumping of water to more daytime pumping at the utility's Jocassee and Bad Creek PSH

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projects in South Carolina, NHA pointed out its report.

That change took place as technologies enabled adjustable speed pump-turbines for faster changes in operations to absorb the solar output during peak solar generation in the middle of the day, rather than curtailing renewables as has been seen in other parts of the country, according to the report.

"I think that will happen more often" as PSH facilities are added in other states in the Southwest, where solar output is soaring, and Northwest, where wind power curtailment has taken place, Manwaring said. Depending on the market they're operating in and power market prices, PSH project owners can get paid to pump water to an upper reservoir to use later for hydropower generation, making money to "charge the water battery," Manwaring said.

PSH facilities send water back and forth between two reservoirs at different elevations, enabling them to generate power and store energy for later use in an upper reservoir. Among the projects in the PSH development pipeline across 21 states, many of them in the West, are closed-loop systems with fewer environmental impacts than the open-loop systems operating today. All PSH projects operating today are open-loop systems that connect to a natural water source for input and output, with more ecological considerations compared with closed-loop systems, Manwaring noted.

Closed-loop PSH projects also can mitigate the effects of the extended drought in the West, where many developers are looking to build new facilities, he added.

Among the PSH projects on the drawing board or going through the FERC licensing process, more than half of the capacity is in the Southwest and the remaining capacity is nearly evenly divided among the Northeast, Northwest and Southeast, NHA said in its report.

Among the challenges listed in NHA's report are that many state policies around renewable portfolio standards, either implicitly or explicitly, do not include hydropower or PSH facilities. Even technology-neutral policies can exclude PSH in favor of other storage options based on short development timelines, NHA says.